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EXAMINER	
LIEW, ALEX KOK SOON	

ART UNIT	PAPER NUMBER
2624	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/679,290	SHISHIDO ET AL.	
	Examiner	Art Unit	
	ALEX LIEW	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 December 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-9,11-13,15,16 and 18* is/are rejected.

7)☒ Claim(s) *5,10,14 and 17* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

This office action is response to the RCE filed on 2/15/08.

Response to Applicant's Arguments

1. The applicant argued in the last reply (filed on 12/8/07), that Hayes does not disclose average slope angle, of the sidewall of fine pattern, information of a ratio of a bottom roundness of the fine pattern and information of a ratio of top roundness. The examiner would like to point out in Hayes, paragraph 44 to 49, equation 2, is the equation use to calculate the average slope angle, Hayes discloses image information includes information of average slope angle of a side wall of the fine pattern (see paragraph 44 to 49, equation 2, is the equation use to calculate the average slope angle); and see paragraph 40 where it discusses the information of a ratio of bottom roundness of the fine pattern and information of a ratio of top roundness of the fine pattern and information of a ratio of top roundness of the fine pattern which are quantified by using information of a first-order differential waveform (see paragraph 40). The examiner read 'ratio' as any constant number because the claim does not call for a division operation, another words, for example, ratio of X to Y, where X and Y are defined parameters.

2. On page 12, the applicant challenged the official notice; the examiner cite Gibas (US pat no 5,675,377); Gibas discloses displaying three-dimensional shape of an object after the three-dimensional shape obtaining process (see figure 1, images are taken at element 12, then processed / manipulated in 66 and then display in 76).

Claim Objections

Claims 5, 10, 14 and 17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

With regards to claim 5, the examiner cannot find any applicable prior art and/or suggestions the information of the ratio of bottom roundness of the fine pattern is quantified by using information of the first-order differential waveform of the ratio of the bottom roundness B/H, where B is the width between a rising point corresponding to a bottom and a maximum point, and the information of the ratio of top roundness of the fine pattern is quantified by using information of the first-order differential waveform of the ratio of the top roundness T/H, where T is a distance between a minimum point and a starting point of a flat portion corresponding to the top of the electron beam image signal in combination with the rest of the limitations of claim 1.

With regards to claims 10, 14 and 17, see the rationale for claim 5.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1 – 4, 8, 9 and 16 rejected under 35 U.S.C. 103(a) as being unpatentable over Houge (US pat no 6,651,226) in view of Hayes (US pub no 2003/0108235).

With regards to claim 1, Houge discloses a method of measuring a three dimensional shape of a fine pattern formed on a substrate, comprising the steps of

obtaining height information about the fine pattern by optically measuring the substrate (see fig 5, element 14, 26 and 32, scatterometer obtains the height information of the substrate, col. 7 lines 39 – 51);

obtaining electron beam image information about the fine pattern by imaging the substrate by means if an electron microscope (see figure 5, elements 12 and 18, electron microscope obtains an image of the substrate, $I_1(x,y)$, column 6 lines 27 to 37); and

measuring the three dimensional shape of the fine pattern by use of the height information and the electron beam image information (see figure 5, elements 36 and 38 the image of the substrate and the height information of the substrate are combined to obtain the shape of the substrate, which is in three dimensional, column 7 lines 52 to 66).

Hogue does not disclose quantifying the values of the slope and roundness of the shape of the object.

Hayes discloses semiconductor image information includes information of average slope angle of a side wall of the fine pattern (see paragraph 44 to 49, equation 2, is the equation use to calculate the average slope angle), information of a ratio of bottom roundness of the fine pattern and information of a ratio of top roundness of the fine pattern and information of a ratio of top roundness of the fine pattern which are quantified by using information of a first-order differential waveform (see paragraph 40). One skilled in the art would quantified the values of the slope and roundness of the shape of the object because the numerical value of the characteristics of the shape of the object can be saved and retrieve using these numerical values, which save storage space compared to storing entire image of shape image.

With regards to claim 2, Houge discloses a method of claim 1, wherein a test pattern is formed on the substrate, and the height information about the fine pattern is obtained from height information about the test pattern determined by optically measuring the test pattern (see column 7 lines 48 to 49, the height information is obtained by scatterometry, which measures amount of light scatter on or surrounding sensor).

With regards to claim 3, Houge discloses a method of claim 1, wherein the height information about fine pattern is obtained from information obtained from scatterometry (see column 7 lines 48 to 49).

With regards to claim 4, Houge discloses a method of claim 1, wherein the electron beam image information about the fine pattern includes plane information about the fine pattern (see figure 1, is an example of a semiconductor wafer image taken by the electron microscope, which provides plane information) and side slope change information about the fine pattern (see figure 2A, provides the slope for each cross section of the wafer, which is located by the edge) and a three dimensional shape of the fine pattern is measured by combining the plane information and side slope change information with the height information about the fine pattern (see figure 5, 34 where the electron beam microscope image information and scatterometer height information are combined to create a three dimensional image, figure 5, element 16, column 8 lines 49 to 55).

With regards to claim 8, see the rationale and rejection for claim 1. In addition, the first pattern is individually form from each cross section, which is examined (see figure 7).

With regards to claim 9, see the rationale and rejection for claim 1.

With regards to claim 16, see the rationale and rejection for claim 1.

2. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Houge ('226) in view of Hayes ('235) and Gibas (US pat no 5,675,377).

With regards to claim 11, Houge discloses a method of measuring a three dimensional shape of a fine pattern formed on a substrate, comprising the steps of

obtaining height information about the fine pattern by optically measuring the substrate (see figure 5, element 14, 26 and 32, scatterometer obtains the height information of the substrate, column 7 lines 39 to 51);

obtaining electron beam image information about the fine pattern by imaging the substrate by means if an electron microscope (see fig 5 – 12 and 18 – electron microscope obtains an image of the substrate, $I_1(x,y)$, col. 6 lines 27 – 37); and

measuring the three dimensional shape of the fine pattern by use of the height information and the electron beam image information (see figure 5, 36 and 38, the image of the substrate and the height information of the substrate are combined to obtain the shape of the substrate, which is in three dimensional, column 7 lines 52 to 66).

Houge does not explicitly disclose displaying three-dimensional shape of the substrate on a screen. Gibas discloses displaying three-dimensional shape of an object after the three-dimensional shape obtaining process (see figure 1, images are taken at element 12, then processed / manipulated in 66 and then display in 76). One skill in the art would want to display a three dimensional model of a semiconductor wafer substrate is because to show the user / operator any defect on the wafer, so the user / operator may take proper steps to correct the defect.

Hogue does not disclose quantifying the values of the slope and roundness of the shape of the object.

Hayes discloses semiconductor image information includes information of average slope angle of a side wall of the fine pattern (see paragraph 44 to 49, equation 2, is the equation use to calculate the average slope angle), information of a ratio of bottom roundness of the fine pattern and information of a ratio of top roundness of the fine pattern and information of a ratio of top roundness of the fine pattern which are quantified by using information of a first-order differential waveform (see paragraph 40). One skilled in the art would quantified the values of the slope and roundness of the shape of the object because the numerical value of the characteristics of the shape of the object can be saved and retrieve using these numerical values, which save storage space compared to storing entire image of shape image.

3. Claims 6, 7 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Houge ('226) and Hayes ('235) as applied to claim 1 further in view of Lorusso (US pat no 6,930,308).

With regards to claim 6, an extension to rejection of claim 1, Lorusso also discloses the electron microscope comprises a plurality of reflected electron detectors, the electron beam image information about the fine pattern is information obtained from a plurality of electron beam images detected by the plurality of reflected electron detectors (see fig 14A and 14B – each rectangular cubed objects are deflectors, which detects electron beam, col. 5 lines 25 – 30). One skill in the art would include a plurality of electron beam detectors each positioned at an angle different from each other because to obtain the

disparity between each obtained image in order to improve depth map and three dimensional image calculation of the object as compared to a single two dimensional image.

With regards to claim 7, an extension to rejection of claim 6, Lorusso also discloses a three dimensional shape of the fine pattern is measured on the principle o photometric stereo processing by use of a plurality of the electron beam images detected by the plurality of reflected electron detectors (see fig 9 showing cross section signal received for each detectors at zero and two degrees, fig 10 shows cross sections for all the images obtained, fig 11 shows the resulting stereo image combined from all the individual signal received by the detectors).

With regards to claim 18, see the rationale and rejection for claim 12.

4. Claims 12, 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Houge ('226) and Hayes ('235) and Gibas ('377) as applied to claim 11 further in view of Lorusso (US pat no 6,930,308).

With regards to claim 12, see the rationale and rejection for claim 11.

With regards to claim 13, see the rationale and rejection for claim 3.

With regards to claim 15, see the rationale and rejection for claim 5.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALEX LIEW whose telephone number is (571)272-8623. The examiner can normally be reached on 9:30AM - 7:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Bella can be reached on (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C Bella/
Supervisory Patent Examiner, Art Unit 2624

Alex Liew
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3/18/08